the highest was 103°, at Glendive on the 17th, and the lowest, 28°, at Adel on the 1st. The average precipitation was 1.34, or 0.10 above normal; the greatest monthly amount, 5.42, occurred at Glendive, and the least, trace, at Billings.—*E. J. Glass.*

Nebraska.—The mean temperature was 73.4°, or 1.3° below normal; the highest was 106°, at Imperial and Madrid on the 25th, and the lowest, 36°, at Kennedy on the 28th. The average precipitation was 2.87, or 0.53 below normal; the greatest monthly amount, 10.85, occurred at Salem, and the least, 0.04, at Cody.—*G. A. Loveland.*

Nevada.—The mean temperature was 72.6°, or about 1.5° above normal; the highest was 110°, at Mill City on the 17th, and the lowest, 34°, at Elko on the 3d. The average precipitation was 0.14, or 0.25 below normal; the greatest monthly amount, 0.61, occurred at Ely, while none fell at several stations. Drought conditions prevailed over the State during the entire month. The ranges in most districts were seriously affected and stock had a hard struggle for existence.—*J. H. Smith.*

New England.—The mean temperature was 69.1°, or about normal; the highest was 101°, at Claremont, N. H., on the 4th, and the lowest, 33°, at Grafton, N. H., on the 1st. The average precipitation was 4.67, or normal; the greatest monthly amount, 8.84, occurred at Pittsfield, Mass., and the least, 1.99, at Nantucket, Mass.—*J. W. Smith.*

New Jersey.—The mean temperature was 74.7°, or about 2.0° above normal; the highest was 98°, at several stations on different dates, and the lowest, 38°, at Charlotteburg on the 1st. The average precipitation was 5.75, or 1.47 above normal; the greatest monthly amount, 9.02, occurred at Bridgeton, and the least, 3.34, at Cape May City.—*E. W. McGann.*

New Mexico.—The mean temperature was 73.0°, or 0.7° below normal; the highest was 106°, at Eddy on the 24th, and the lowest, 29°, at Winsors on the 12th. The average precipitation was 4.11, or 1.22 above normal; the greatest monthly amount, 10.51, occurred at Clayton, and the least, 1.00, at Eddy.—*R. M. Hardinge.*

New York.—The mean temperature was 70.3°, or 0.5° above normal; the highest was 101°, at Cedar Hill on the 3d, and the lowest, 35°, at Bolivar and New Lisbon on the 1st and at Saranac Lake on the 20th. The average precipitation was 3.72, or 0.17 below normal; the greatest monthly amount, 10.49, occurred at Port Jervis, and the least, 0.70, at Madison Barracks.—*R. G. Allen.*

North Carolina.—The mean temperature was 76.5°, or 1.0° below normal; the highest was 102°, at Rockingham and Salisbury on the 16th, and the lowest, 40°, at Linnville on the 1st. The average precipitation was 6.51, or 0.90 above normal; the greatest monthly amount, 12.15, occurred at Selma, and the least, 2.12, at Marion—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 68.3°, or 0.4° below normal; the highest was 109°, at Steele on the 21st, and the lowest, 32°, at Dunseith, on the 29th. The average precipitation was 1.88, or 0.49 below normal; the greatest monthly amount, 6.12, occurred at Sheyenne, and the least, 0.45, at Bismarck.—*B. H. Bronson.*

Ohio.—The mean temperature was 74.1°, or about normal; the highest was 105°, at Seaman on the 4th, and the lowest, 41°, at Orangeville on the 10th. The average precipitation was 4.18, or 0.22 above normal; the greatest monthly amount, 6.45, occurred at Levering, and the least, 1.51, at Vanceburg—*J. Warren Smith.*

Oklahoma.—The mean temperature was 79.8°, or about normal; the highest was 106°, at Kemp on the 13th, and the lowest, 59°, at Beaver on the 1st and Kemp on the 12th. The average precipitation was 6.05, considerably above normal; the greatest monthly amount, 14.00, occurred at Fort Sill, and the least, 1.35, at Norman—*H. L. Ball.*

Oregon.—The mean temperature was 66.1°, or about normal; the highest was 107°, at Pendleton on the 13th, and the lowest, 26°, at Silverlake on the 1st. The average precipitation was 0.15, or 0.34 below normal, the lowest on record for July; the greatest monthly amount, 1.15, occurred at Stafford, while no rain fell in several counties.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 72.3°, or 1.0° above normal; the highest was 101°, at Aqueduct on the 22d, and the lowest, 35°, at Dushore on the 1st. The average precipitation was 3.91, or nearly normal; the greatest monthly amount, 8.24, occurred at Seisholtzville, and the least, 1.53, at Lewisburg.—*T. F. Townsend.*

South Carolina.—The mean temperature was 80.0°, or about normal; the highest was 105°, at Columbia, Greenwood, and Little Mountain on the 15th, and the lowest, 47°, at Holland on the 4th. The average precipitation was 4.03, or 1.99 below normal; the greatest monthly amount, 10.16, occurred at Temperance, and the least, 1.58, at Trenton.—*J. W. Bauer.*

South Dakota.—The mean temperature was 72.4°, or about normal; the highest was 111°, at Interior on the 22d, and the lowest, 32°, at Ashcroft on the 28th. The average precipitation was 2.02, or about 0.89 below normal; the greatest monthly amount, 6.83, occurred at Canton, and the least, 0.28, at Forestburg. The precipitation was excessive over portions of Bon Homme, Clay, Lincoln, Turner, and Union counties.—*S. W. Glenn.*

Tennessee.—The mean temperature was 77.5°, or about 1.0° above normal; the highest was 101°, at Dover on the 15th and 16th, and the lowest, 44°, at Silverlake on the 9th and 10th and at Erasmus on the 10th. The average precipitation was 4.53, or about normal; the greatest monthly amount, 7.58, occurred at Lafayette, and the least, 1.61, at Covington.—*H. C. Bate.*

Texas.—The mean temperature, determined by comparison of 42 stations distributed throughout the State, was 0.6° below the normal; there was a slight excess for the month in a few scattered localities and a general deficiency elsewhere; the highest was 110°, at Desdimonia on the 23d, and the lowest, 44°, at Marathon on the 10th. The average precipitation, determined by comparison of 48 stations distributed throughout the State, was 0.44 above the normal. There was a general excess ranging from 1.00 to 5.19 over west Texas, the Panhandle, the western portion of north Texas, the eastern portion of southwest Texas, and in Galveston, Brazoria, and Fort Bend counties, with the greatest at Wichita Falls. Over the other portions of the State there was a general deficiency, with the greatest over the eastern portion, where the deficit ranged from 1.00 to 2.00. The rainfall was very unevenly distributed over the State. The greatest monthly amount, 12.70, occurred at Alvin, while none fell at several stations.—*I. M. Cline.*

Utah.—The mean temperature was 73.3°, or 1.0° above normal; the highest was 107°, at St. George on the 1st and 27th, and the lowest, 30°, at Woodruff on the 23d. The average precipitation was 0.66, or 0.01 above normal; the greatest monthly amount, 3.07, occurred at Grover, and the least, trace, at Blue Creek, Croydon, and Ogden. On the evening of the 11th a flood, produced by heavy rain or a cloudburst in the mountains, swept down Manti Canyon, struck Manti, which is located at the foot of the canyon, and damaged buildings and other property to the extent of about $25,000 or $30,000.—*L. H. Murdoch.*

Virginia.—The mean temperature was 75.7°, or about 1.0° above normal; the highest was 101°, at Doswell on the 22d, and the lowest, 35°, at Hot Springs on the 10th. The average precipitation was 4.48, or slightly in excess of the normal; the greatest monthly amount, 10.41. occurred at Sunbeam, and the least, 1.42, at Clifton Forge.—*E. A. Evans.*

Washington.—The mean temperature, was 66.1°, or about 1.5° above normal; the highest was 112°, at Lind on the 16th, and the lowest, 32°, at Colfax on the 23d. The average precipitation was 0.36, or 0.26 below normal, or about 58 per cent of the normal amount; the greatest monthly amount, 1.59, occurred at Coupeville, while none fell at Centerville, Connell, Lyle, and Sunnyside.—*G. N. Salisbury.*

West Virginia.—The mean temperature was 73.3°, or 0.6° above normal; the highest was 100°, at Uppertract on the 22d, and the lowest, 33°, at Terra Alta on the 10th. The average precipitation was 3.78, or 0.89 below normal; the greatest monthly amount, 7.92, occurred at Philippi, and the least, 0.20, at Beckly.—*C. M Strong.*

Wisconsin.—The mean temperature was 70.3°, or nearly normal; the highest was 102°, at Medford on the 25th, and the lowest, 34°, at the same station on the 30th. The average precipitation was 3.19, or 0.13 above normal; the greatest monthly amount, 7.60, occurred at Gratiot, and the least, 0.75, at Medford.—*W. M. Wilson.*

Wyoming.—The mean temperature was 65.6°, or 1.0° below normal; the highest was 108°, at Bittercreek on the 25th, and the lowest, 28°, at Rock Springs on the 3d and at Burns on the 23d and 29th. The average precipitation was 1.28, or slightly above normal; the greatest monthly amount, 3.28, occurred at Cheyenne, and the least, 0.07, at Wamsutter.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

COLD WAVES IN THE SOUTHWEST.

J. S. HAZEN, Observer, Weather Bureau.

The remarkable, intense, and far-reaching cold waves of the past winter, culminating in that phenomenal and record-breaking cold wave of February 11–14, 1899, gave lower temperatures in many sections than had ever been known, and has done much to bring the work of the Weather Bureau before the people, and to give an impetus to the study of the phenomena attending such storms.

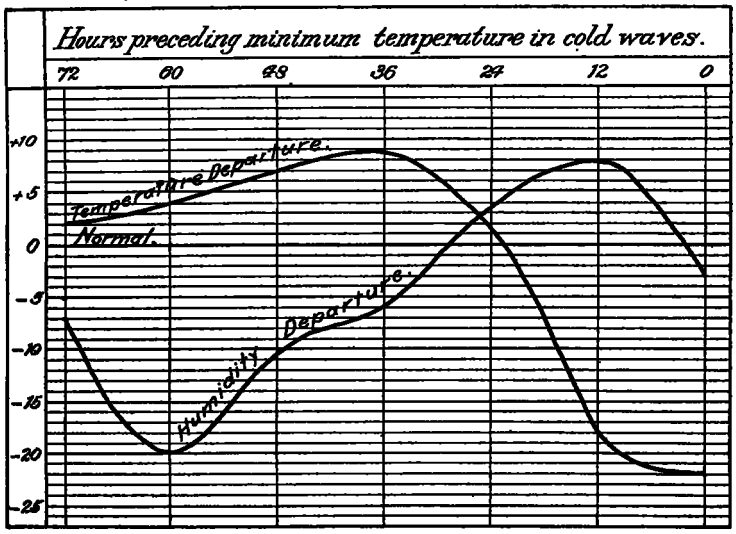
The local and visible conditions or premonitions preceding a cold wave in the Southwest are, with the possible exception of the relative humidity, uniform and well known. The first, and absolutely essential element, is an area of low barometric pressure in the Southwest. This low area may develop in the Southwest, or move down the eastern slope of the Rocky

Mountains, or may come from the Gulf and unite with a disturbance from the Southwest. Such a condition naturally gives to the southwest section of the Mississippi watershed several days of southerly winds, and temperatures much above the seasonal normal. The atmospheric moisture will also be drawn into this section by the southerly winds, until it attains a large excess over the monthly normal. There may or may not be precipitation preceding the crest of the cold wave, but usually some sections of the area involved will receive a portion of the surplus moisture in the form of rain or snow. Those who encountered the cold waves of the past winter need not be told of the suddenness with which a warm, brisk breeze from the south or southwest can shift to the northwest and the temperature begin its rapid descent toward the zero point.

There is one point, however, which is not so noticeable; this is the element of relative humidity. There is apparently a low and a high humidity. The low usually, if not always, precedes the advance of the area of low pressure, and the high humidity is considerably in advance of the high pressure area. The visible signs of a low humidity are not well marked, but an increase in the relative percentage of moisture in the atmosphere is very conspicuous. Every one who has observed carefully the conditions preceding a sudden change in temperature, must have remarked the peculiar thickening appearance which the sky undergoes. There seems to be an impalpable filling up of the upper air, giving to the sky an appearance of light haze. This condition was especially noticeable preceding the cold wave of February 12 and 13, 1899. Six hours before the temperature began to fall rapidly, a dull, somber, hazy, veil-like streak was observed along the northwest horizon, which gradually increased and darkened until the entire sky was a leaden gray. From this condition, fine cirro-stratus clouds eventually formed.

The relationship existing between the pressure, temperature, and humidity elements, at the earth's surface, have been so thoroughly and systematically studied, that it seems hopeless to attempt any further researches in this line. But one line of investigation, which, in the opinion of the writer, is more than usually promising, is the relation between the humidity crest, the temperature crest, and the pressure crest.

Instead of publishing the sixteen examples in full the following table shows in condensed form the temperature and humidity departures for each 8 a. m. and 8 p. m. observation preceding the arrival of the lowest temperature. The general average departures are also shown in the following diagram.



A study of the departures from normal values for 8 a. m. and 8 p. m., as to temperature and relative humidity, for sixteen cold waves, indicates that there is more than a casual relation between heat waves, cold waves, and relative humidity, or moisture waves. Of course the results obtained from one station are not sufficient to predicate a theory upon, but in these sixteen examples, which were selected at random, there is a uniformity in the relationship shown, which must be more than accidental.

It will be seen that in nearly every case, the relative humidity is the element in which we first perceive a rapid and violent fluctuation; the percentage generally reaches its lowest point at, or within, a few hours of the time at which the temperature begins a rapid fall. At the period of low humidity, the greater the departure from normal humidity, the greater the fall in temperature is likely to be. The farther the low humidity is in advance of the low pressure and high temperature, the more apt we are to have a period of cold weather extending over two days or longer. The first eleven examples show that the lowest temperature occurs when the humidity is above the monthly normal. In the remaining five examples the humidity is but slightly below the normal, notwithstanding the generally accepted belief that a high pressure area is associated with dry cold air.[1] This would seem to indicate that the coldest weather closely follows a period of abnormally low humidity, followed by a rapid increase in humidity until about the time the lowest temperature occurs, when the humidity element is above normal. The downpour of cold air from the higher regions does not occur until the minimum temperature has been reached and the temperature has begun to rise.

Cold wave No. 16 shows the conditions preceding the severe cold period from February 12 to 14, when for several days the temperature and humidity were both below normal, with a general tendency of the temperature downward, but with humidity about stationary.

Temperature and humidity preceding cold waves at Springfield, Mo.

Cold wave number.	Date of arrival.	Departure from normal.												
		Temperature, degrees F.							Relative humidity, per cent.					
		Hours in advance.							Hours in advance.					
		72	60	48	36	24	12	0	72	60	48	36	24	12	0
1	1891, Dec. 26, a. m.	+ 0	+ 1	+ 1	+ 5	+12	−22	−23	+11	+17	+16	−14	−10	+24	+11
2	1898, Dec. 31, a. m.	+10	+20	+18	−25	− 6	−18	−19	− 6	−35	−32	− 8	+ 5	− 2	−17
3	1898, Nov. 22, a. m.	+ 4	+12	+14	+20	+19	−32	−14	− 9	−30	−20	−20	−12	− 4	− 8
4	1897, Nov. 23, a. m.	+ 9	+17	+21	+20	+ 3	−18	−16	−31	−40	− 1	0	+10	+ 9	−12
5	1897, Jan. 25, a. m.	+ 9	0	− 1	+15	−19	−29	−26	− 6	−18	+ 2	−17	− 4	+ 7	− 5
6	1896, Jan. 3, a. m.	− 2	+ 5	+ 1	+ 5	+13	−14	−26	− 1	−19	−28	−19	−23	− 2	+ 3
7	1894, Feb. 20, a. m.	+19	+ 2	+ 2	+14	+ 1	− 8	−10	+ 1	+16	+11	−16	+ 3	+ 9	+ 9
8	1894, Jan. 24, a. m.	+12	−11	− 1	− 5	0	−27	−45	+12	−12	+11	+ 5	+ 8	+20	+ 7
9	1893, Dec. 16, a. m.	− 3	− 9	+ 6	+16	+25	− 9	−13	−38	− 1	−14	+ 2	+22	− 9	+ 1
10	1893, Jan. 13, a. m.	−13	− 7	+ 3	− 4	− 8	− 9	−23	− 5	−18	0	− 3	+ 5	+ 6	0
11	1892, Jan. 19, a. m.	− 3	0	+ 4	0	−15	−26	−31	− 4	−12	− 5	+20	+ 9	+18	−17
12	1893, Feb. 15, a. m.	− 8	−14	− 7	− 9	− 5	−18	−24	+ 7	−14	+ 3	+28	+ 5	+ 2	+ 7
13	1895, Jan. 12, a. m.	−14	0	0	− 2	+ 5	−17	−35	+ 4	−22	−10	−28	+ 3	−12	−21
14	1892, Feb. 15, a. m.	−12	+ 3	+ 9	+10	− 1	−16	−14	+ 5	−30	−47	+ 3	−13	−11	− 2
15	1892, Mar. 14, p. m.	+ 5	+16	+ 8	− 2	− 4	−20	−13	−23	−35	−16	−11	+12	+19	+ 6
16	1899, Feb. 9, a. m.	− 7	−13	−13	−16	−19	−26	−32	+11	− 9	−24	−18	− 6	−24	−12
	Average departure	+ 2	+ 4	+ 6	+ 8	+ 2	−19	−22	− 6	−20	− 9	− 7	+ 5	+ 8	− 5

CONCLUSIONS.

1. Preceding cold waves, with temperature above normal,

[1] The general idea that dry cold air is associated with high barometric pressures is probably quite correct, no matter whether we consider the absolute humidity or the percentage of relative humidity. The apparent exception noted by Mr. Hazen occurs generally during the early morning hours and near the ground, at which time and place the local temporary temperature is so low that a high relative humidity, and even fog, may be observed. At the same place, in the middle of the day, a very low relative humidity will be observed without any corresponding change in the absolute humidity. As the relative humidity depends on both moisture and temperature, the air that is cold and foggy for an early morning temperature of −10° F. becomes cold and dry in a midday temperature of 0° or + 10° F., and very dry when still further warmed up during the next few hours.—ED.

there is a low humidity, which is in advance of, or coincident with, the fall in temperature.

2. The lower the humidity falls and the more violent its fluctuations, the greater will be the fall in temperature.

3. The earlier the low humidity reaches the station in advance of the fall in temperature, the longer will the period of cold last.

4. Coincident with, or shortly before the lowest temperature, the humidity usually attains a value above normal and begins to fall as the temperature begins to rise.

EVERY MAN HIS OWN WEATHER PROPHET.

By J. HOWARD HOPKINS, Ruxton, Md. (dated July 25, 1899).

The rules laid down under the above title by the Baltimore Trade have been examined by me with the following results:

The assertion that the extreme cold spells of the winter are just six months after the hottest spells of summer does not, except in one or two instances, at all agree with my own observations. I have been keeping private records for the past four or five years, making temperature my principal observation. The warmest periods of weather for June, July, and August, 1895, were certainly not followed in six months by the coldest weather for December, January, and February, respectively. To be sure it was moderately cool for the season during the first few days of December, 1895, but it was by no means the complement of the corresponding days of June, when the temperature was remarkably high for the season. The warmest period of September of that year, it is true was followed by a severe cold spell in March, but might not this have happened by mere chance? In 1896, only the cold wave of the following January corresponds to the warm period of July; June, August, and September had no cold waves during the next winter to follow their warmest periods.

In 1897 I can find nothing at all that confirms the truth of the Baltimore Trade rule.

As for 1898, December shows no cold waves that correspond to the hot weather which prevailed from June 24 to 28. January, 1898, had a severe cold wave, corresponding with the extreme heat of July 1–4 preceding, but the great cold spell of February 9–15, 1898, had no complementary hot period in August, 1897. September, 1898, had a hot spell, which was followed in March, 1899, by a period of rather cool weather but the coolness was not to be compared with the preceding excessive heat.

As regards the statements that the last week in March determines the character of the last week in September, and, that if the weather from March 22 to the end of the month is warm, there will be great danger of frosts during the last week in September, or vice versa—I find my records agree no better with this than in the previous cases, and my records are kept quite as accurately as is practicable.

A STUDY OF TEMPERATURES AT BALTIMORE, MD.

By F. J. WALZ, Local Forecast Official and Section Director.

In the Baltimore Sun of February 2, 1899, there appeared an editorial article stating that the Baltimore Trade had deduced a general rule for temperature forecasting, based on a study of the tables of temperature printed in the Sun Almanac for a number of years past. This rule, it is claimed, is based on statistics which show that from the record of spring and summer anomalies in temperature an inference may be had as to the fall and winter temperature anomalies which will follow just six months later in the same locality; in other words, the extremes in fall and winter conditions are the complement of the extremes in the spring and summer conditions immediately preceding, and the interval of time is almost invariably a period of six months. The statement was also made that the rule could be put to practical use, which would result in much benefit in cases where business interests were likely to be affected by temperature extremes. March 22 is given as the epoch or initial date from which calculations are to be reckoned.

The temperature tables in the Sun Almanac are furnished by the Weather Bureau office in Baltimore, and are consequently official and reliable, so that no exception can be taken to the material used in the studies made by the Trade. Acting on the suggestion of the Editor of the REVIEW, whose attention to the article had been called by Mr. Howard Hopkins, of Ruxton, Md., I have carefully examined and compared the temperature records of this station for the past seven years, beginning with March 22, 1892, with a view of proving or disproving the value of the system of long-range temperature forecasting evolved by the Baltimore Trade.

In the tables which follow the facts thus obtained are presented (1) in a summary of results secured by comparing the warm and cold periods of each month with the conditions prevailing six months later; (2) by a statement of results obtained through a comparison of the warmest and coldest days of each month with the data recorded six months later; and (3) by a table showing the absolute highest and lowest temperatures for each year and the dates of their occurrence.

An exact verification is one in which an extreme of spring or summer heat or cold during a given month is followed six months later by an extreme of the opposite nature. A partial verification is one in which the extreme is followed by its opposite to a mild degree only. A nonverification, or failure, is an instance in which the Trade rule does not hold good. And an opposite result, as given in the tables, is an instance in which an extreme thermal condition has been followed six months later by an extreme of the same order.

TABLE 1.—*Summary of results in testing Baltimore Trade long-range temperature forecast rule when applied to warm and cold spells of two or three days or more duration.*

	Exact.	Partial.	Failure.	Opposite.
March 22-31 with September 22-31	1	4	7	8
April with October	3	6	22	4
May with November	3	10	21	9
June with December	2	10	21	3
July with January	2	12	16	3
August with February	1	3	27	2
September 1-21 with March 1-21	3	6	15	6
Total	15	51	139	35

TABLE 2.—*Summary of results in testing Baltimore Trade long-range temperature forecast rule when applied to the warmest and coldest days in each month.*

	Exact.	Partial.	Failure.	Opposite.
March 22-31 with September 22-31	1	3	9	1
April with October	2	5	6	1
May with November	0	5	5	4
June with December	1	7	4	1
July with January	1	5	4	4
August with February	1	4	4	3
September 1-21 with March 1-21	2	5	3	4
Total	8	34	35	18

TABLE 3.—*Highest summer and lowest winter temperatures for each season, with dates of occurrence, since* 1892.

Highest.	°	Lowest.	°
1892, July 26	99	1893, January 16	1
1893, June 20	98	1894, February 25	8
1894, June 24	98	1895, February 6	1
1895, June 1 and 3	97	1896, February 17	5
1896, August 7	98	1897, January 26	8
1897, June 30	95	1898, February 2	10
1898, July 3	104	1899, February 10	−7